

By DR. JOHN FELTWELL F.R.E.S., F.L.S., MIBiol.*

Abstract

Pupal spines of *P.brassicae* do not appear to have been witnessed very often and have been described only a handful of times from England, India, Morocco and Sweden. They occur as a pair of spines on the dorsolateral side of the third abdominal segment. Here fresh observations of spines, this time from French specimens, are presented and weighed up in light of the scanty information recorded previously. Unpublished observations by Allcard and Feltwell make it likely that predators influence spine development.

New Observations

In September 1978 larvae of *P.brassicae* feeding on cabbage were brought back to England from the Cévennes mountains in France (Gard, 30440). From a total of 251 pupae, 239 developed spines, thus making a high percentage of 95.2% with spines. The distinctive spines measured up to 2mm in length, were uniform in structure throughout the batch and the distal half was always black (Figure 1).

Previous Accounts

The first account of pupal spines in *P.brassicae* is that of William Buckler (1886) who stated that 'there is a variety in which this second prominence becomes quite a spike'. He also stated that a Dr. (R.C.R. ?) Jordon sent him some similar specimens in 1874. The phenomenon has also been seen in India as Ghosh (1914) says of *P.brassicae* pupae that 'at the spiracular region on each side of the second, third and fourth abdominal segments there is a ridge which protrudes into a spine on the third abdominal ridge.'

Two short accounts of *P.brassicae* spines were published by Green (1927) who noted a single specimen found 'attached to a bramble leaf, in a country lane, far from any cabbage patch,' and Main (1937) who collected 16 out of 46 pupae with spines from a garden 'in the Epping Forest district.'

A more detailed study of *P.brassicae* spines was made by Johansson (1959) who also attempted to explain their function. Using a sample of 603 pupae collected in Oslo and Copenhagen between 1950 and 1953, he found that there was a greater tendency for non-diapausing pupae to possess a spine. However, he admitted that his results were not clear cut, and that the presence or absence of spines could not be relied upon to separate non-diapausing pupae.

*Marlham, Henley Down, Catsfield, East Sussex TN33 9BN

DORSAL VIEW

LATERAL VIEW

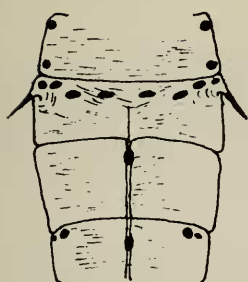


Fig. 1 Pupal spines of *P. brassicae* drawn from exuviae.

Factors Affecting

A number of observations or apparent correlations have been made between the occurrence of spines and various physiological features, but little has been written on the extrinsic or intrinsic factors affecting spine development.

(a) *Diapause*

It was the belief of Johansson (1959) that non-diapausing pupae of *P. brassicae* would be more likely to have spines than diapausing ones. He pointed out that the reason why textbooks on European butterflies never illustrate *P. brassicae* with spines is because they always depict the readily available diapausing ones. Further south in Europe he argues, there is a chance that spines may be found on non-diapausing pupae and draws attention to observations made in India by Ghosh (1914) that the pupae have 'a ridge which protrudes into a spine on the third abdominal segment'.

Certainly the spines found by Allcard in Morocco (April) and Feltwell in France (September) were non-diapausing and would support Johansson's views. However, experience has shown that non-diapausing pupae reared in continuous culture do not have noticeably larger spines compared with diapausing pupae. There is the possibility though that various characteristics of the wild forms of *P. brassicae* may have been bred out during the last 20 years of inbreeding in the laboratory.

(b) *Sexual differences*

There appears to be no correlation between sexes and presence or absence of pupal spines (Johansson, 1959). Equal

numbers of each sex were hatched from spiny pupae by Main (8:8 hatched end of September) and by Feltwell (83:83 hatched 9th October onwards).

(c) *Larval characteristics and diseases*

No correlation could be made between non-spiny and spiny pupae and their setal arrangement or colour of the fifth instar larvae. Some of the larvae and pupae suffered from virus disease and were later found to have microsporidia and a granulosis virus, both in high concentrations, by the Unit of Invertebrate Virology at Oxford.

(d) *Foodplants*

In the French specimens the larvae had been eating cabbage. This is particularly interesting as the larvae were collected from different gardens but they were all reared on the same cabbage. It is not thought likely that rearing techniques influenced spine development. The spiny pupae from Morocco had been eating the very large leaved Nasturtium (*Tropaeolum* sp.).

(e) *Genetic similarities*

The pupae of the subspecies *Pieris brassicae cheiranthi*, which live on the Canary Islands, have pupal spines (Gardiner, 1979 *pers. comm.*). The isolation and speciation of this subspecies on these islands has evoked considerable attention, but it does not appear that evidence of a mainland origin has ever been found.

(f) *Predators*

It has been proposed by Allcard (1979, *pers. comm.*) that the pupal spines of *P. brassicae* may have been evolved for protection against predators, and that they occur only in areas where there are many lizards. This is also in accordance with observations made by Feltwell in France. Here there are many lizards, the most numerous being the Common Wall Lizard (*Podarcis muralis*) followed by the large and impressive Green Lizard (*Lacerta viridis*). These lizards frequent the stony countryside and find ample refuge in the rock walls of the hill-terracing, as well as being found in the small gardens from which the larvae were collected. Another influence on larvae on wild crucifers may also be from chickens which roam free-range around the garden area but outside the growing crops. These birds have eyes like eagles for anything which moves, for they have literally to scratch an existence from the life in and on the soil and plants. Outside the terrace gardens, everywhere is constantly nibbled down by goats and sheep, so it is possible that general grazing as well as feeding stimuli from reptiles and birds is involved in spine determination.

As Allcard points out, there is little spine formation in

Madeira where *P. brassicae* feeds on cabbage grown at 2,000 -2,500 ft (609-762 m) on northern slopes where fewer lizards are found. He also mentions that small birds may be involved and that there are a 'number of small birds on the Canaries and many more in Morocco'.

Acknowledgments

I would like to thank Mr. H. G. Allcard for sharing his observations and ideas about spines in *P. brassicae* and Linda Spencer of the Unit of Invertebrate Virology at Oxford for supplying details about virus infections.

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THE BRIMSTONE BUTTERFLY OVIPOSITING ON DOCK. — On the 15th April 1981, I was walking about my local gravel pit here, when I saw a female Brimstone (*Gonepteryx rhamni* L.) flying along a large hedge of buckthorn (*Rhamnus catharticus*) and hawthorn (*Crataegus monogyna*), and shortly after noticed she had begun ovipositing in characteristic manner. She also seemed quite interested in the hawthorn, and was seen three or four times, through binoculars, curling her abdomen on its leaves, but it was too high up for me to find any eggs, if laid.

After I had collected two eggs from the buckthorn, I lost sight of the butterfly for two or three minutes, and when re-sighted it was about 20 yards away flying along a similar habitat but lacking buckthorn. I then followed her for a short distance and to my amazement she began to oviposit on a species of dock (later identified as Broad-leaved dock: *Rumex obtusifolius*). Although it curved its abdomen three times on separate leaves, only one egg was found, in the typical place along the mid-rib and near the tip of the leaf. The early date of ovipositing is also exceptional I believe, since most books give the normal time for this as occurring in May. — D. FROST, "Yelkonan", 14, Chauncer Way, St. Ives, Huntingdon, Cambs PE17 4TY.